

mission the resources of Egypt were not equal to finding the money. In these circumstances, English enterprise came to the rescue. Sir Ernest Cassel, backed by a financial syndicate, undertook to find the money and Sir John Aird contracted to carry out the work. The capital fund is to be repaid by instalments of 166,000*l.* extending over thirty years, and it is anticipated that the irrigation will produce a revenue of 400,000*l.* a year. Sir Benjamin Baker has been the consulting engineer, and the work was carried out under the direction of Mr. Fitzmaurice, lately appointed engineer of the London County Council. The dam has thus been entirely carried out by English enterprise and English capital.

THE VELOCITY OF PROPAGATION OF X-RAYS.

M. R. BLONDLOT has recently made an experimental determination of the velocity of propagation of X-rays, as a result of which he finds that they travel with the same velocity as light. The full account of the work is published in the *Comptes rendus* for October 27 and November 3 and 10 (vol. cxxv. pp. 666, 721 and 763), and a translation of the first two papers is given in the *Electrician* for November 21. As the subject is one of great importance, the following brief abstract of the methods used and the results obtained may be of interest to the readers of NATURE.

The method is based on a principle similar to that of Römer's method of determining the velocity of light. The arrangement of the apparatus is shown diagrammatically in Fig. 1. B and B'

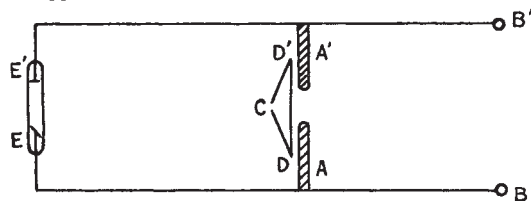


FIG. 1.—Diagram of M. Blondlot's apparatus.

represent the terminals of the secondary of an induction coil which are connected to the poles A, A' of a Hertz radiator and to the electrodes E, E' of an X-ray tube. Beneath the Hertz radiator is placed a resonator consisting of a copper wire folded into the shape of a triangle DD'C. The spark gap, C, of this resonator is so placed that it receives the X-rays from the focus tube, but is protected from all other radiation by screens of black paper and an aluminium plate. The oscillator AA' consists of two brass cylinders arranged horizontally in a bottle of vaseline oil. By suitably altering the length of the spark gap, the oscillator and the focus tube can be made to work simultaneously. The action is then as follows:—At each current of break, the potential between B and B' rises sufficiently for the X-ray tube to respond. As the potential continues to rise, a spark passes in the oscillator, and this, withdrawing energy from the focus tube, extinguishes it. By careful adjustment, the spark potential of the exciter can be made only slightly greater than the potential necessary to work the tube, in which case the tube will be extinguished very soon after the beginning of the oscillatory discharge, at the end of a time less than a quarter of the period of the radiator. The electric force at the resonator gap only reaches its maximum after a time equal to half the period of the oscillator; hence if the X-ray tube is close to the gap, the X-rays having been extinguished prior to this, there can be no action of the tube on the secondary spark. This conclusion is verified by interposing a sheet of lead between tube and gap, when it is found that the spark is not affected.

Now let the focus tube be kept in the same position and the wires AE and A'E' be lengthened each by the same amount. This has the effect of delaying the extinction of the tube by the time required for the Hertzian waves to traverse this extra length of wire, and consequently the disappearance of the X-rays at the spark gap C is delayed by the same amount. The X-rays can, therefore, act upon the spark, and that they do so is shown by the fact that the interposition of a lead sheet now makes the spark less bright. If, on the other hand, the wires AE and A'E' are kept of constant length and the tube moved farther away from the gap, then the X-rays will experience a retardation equal to the time they take to travel from the tube to the gap.

The effect of moving the tube farther off should, therefore, be the same as that of lengthening the wires, and this is again confirmed by experiment; the spark grows brighter as the tube is moved away, but if a lead sheet be interposed, the brightness is unaffected by moving the tube. For a certain distance between tube and gap, the X-rays will have at the gap their full intensity during the whole of the time the potential at the gap has an appreciable value; at this point their effect is a maximum, for increasing the distance diminishes their intensity without increasing the time during which they and the electric force act together at the gap. This position of maximum can be found by experiment.

Let v and v' be the rates of propagation in centimetres per second of the Hertzian waves and the X-rays respectively, and after determining the position of the tube giving the maximum spark when the connecting wires AE and A'E' are of given length, let these wires be lengthened by a cm. The cessation of X-rays at the gap is thus retarded by a/v seconds. In order to re-establish the coincidence of the times and to find the new maximum, the tube must be moved nearer to the gap by a length β cm., such that $\beta/v' = a/v$. The experiment gives β/a , and therefore v'/v . The following table gives the results of a series of experiments, the first column giving the values of a , the second and third columns the values of β as determined by M. Blondlot himself and his assistant, M. Vitz, respectively, and the fourth column the mean of these two values. Each of the numbers in columns 2 and 3 is the mean of five determinations.

a	β		
	Blondlot.	Vitz.	Mean.
- 7	- 5'9	- 6'5	- 6'2
9	10'5	8'9	9'7
12'5	12	12'6	12'3
15	15'1	14'5	14'8
25	25'3	24'5	24'9
30	31	30	30'5
40	39'3	39'6	39'4
25	24'6	23'2	23'9

The mean result of all the experiments in this and other series gives the value 0.97 for the ratio v'/v .

A variation of the method was also tried in which the ends of the resonator were separated by 0.3 cm., and two wires soldered to them and connected to a micrometer spark gap. These wires were bent back on themselves so as to bring the new gap into the same position as the old one. The Hertz waves have to traverse these wires before producing the spark, and if each wire is lengthened by a cm., the spark is retarded by a/v seconds. To obtain the new maximum, the tube must be moved away from the gap by a distance β cm. such that $\beta/v' = a/v$. A number of very concordant experiments by this method gave a mean value 0.93 for the ratio v'/v .

The final result of all the experiments, therefore, leads to the conclusion that the velocity of propagation of X-rays is equal to that of Hertzian waves or of light through the air. M. Blondlot concludes his papers by pointing out that this conclusion is in harmony either with the hypothesis that X-rays are radiations of very short wave-length or with that of E. Wiechert and Sir George Stokes, that they are electromagnetic impulses produced by the impact between the molecules or electrons in the cathode stream and the antikathode. The fact brought out by these experiments that the X-rays cease simultaneously with the current traversing the Crookes' tube, also supports the latter hypothesis. MAURICE SOLOMON.

RECENT DIETARY STUDIES.

THE character of the daily menu is influenced by various considerations, but it will be universally conceded that the idiosyncrasies of the palate play the predominant part, and to suggest to the ordinary housekeeper that scientific principles should be allowed a voice in the determination of our diet would be simply to court ridicule, for of all departments of the household the kitchen is probably the most conservative in its customs and the most dominated by habit and tradition. It will not be

the fault of our Transatlantic cousins, however, if the reign of ignorance and indifference in this department of domestic life be permitted to continue, for the United States Board of Agriculture has recently published a series of bulletins or reports on the dietetic value of food stuffs of various kinds, embodying also the results of dietary studies on individuals carried out in all parts of the country.

These studies have not been confined to a particular class of persons, but have been undertaken in connection with the well-to-do as well as with the very poor, and embrace people engaged in hard physical work as well as those whose occupation is more sedentary in character; in fact, the common labourer and the average professional man are both represented in the types selected.

Of particular interest are the studies recorded of the dietary habits of the Chinese, for tradition assigns to this race the highest attainment in the art of producing from a given area the maximum amount of food material. This success is due firstly to a much more "intense" cultivation of the land than is customary in the western hemisphere, and secondly to the utilisation of a great variety of food plants, many of which are quite foreign to our culinary arts, but the employment of which enables the Chinaman to exploit every kind of soil and climate and compel it to yield up its quota of food material.

Thus a European visiting the Chinese market of San Francisco would have some difficulty in realising that the wares displayed were for culinary purposes, for amongst other garden plants he sees costly lily roots which he has been in the habit of importing at a high price with which to adorn his conservatories, here offered for sale as an attractive addition to the diner's menu. Many varieties of lily bulbs are eaten both by the Japanese and Chinese, but that principally on offer in the San Francisco Chinese market is the *L. brownii*. They are regarded as a delicacy and an especially desirable food for invalids, and are usually eaten but slightly cooked and with the addition of sugar. Chemical analysis shows the albuminoids present to be distinctly greater than in potatoes, but the most important constituent of the bulbs is starch, which is present in sufficient amount to endow them with a high nutritive value as a food stuff. But not only are the bulbs of lilies eaten; the dried flowers of the lovely day lily, *Heemerocallis fulva*, so sought after by all lovers of gardens on account of its rich colour and wealth of blossom, are largely used and highly prized by the Chinese as a flavouring ingredient. This article is sold under the name of "Kam cham t'soi" or the "gold-needle vegetable," and it has been found to possess a not inconsiderable nutritive value, besides being an attractive condiment.

Space does not permit of a reference to all the numerous and, to our ideas, strange articles which a Chinaman draws upon for dietetic purposes, but some mention must be made of the plant which both tradition and art have from time immemorial endowed with such a full measure of religious and classical associations.

To those of us who associate the *Nelumbium speciosum* of the botanist with the "mild-eyed, melancholy lotus eater," of the poet "whose voice was thin as voices from the grave," whilst "deep asleep he seemed yet all awake," the extensive economic use to which the lotus plant is put comes as a surprise. Whilst sought after on account of its surpassing beauty and grown in some parts in great vases placed at the doors of the houses, its more material applications are both numerous and varied. Thus we read, in a report published by Jules Grisard in 1896, that the stamens are used in China as an astringent remedy and also for the toilet; the petioles and peduncles furnish a viscid sap employed in India as a remedy for vomiting and diarrhoea; the fibro-vascular bundles of the petioles are made into lamp wicks, and the carpophore furnish a popular remedy for blood spitting. The seeds are eaten either raw, boiled or roasted, much as we use chestnuts, but the dark green germ is very bitter and is removed before use, and has given rise to the Chinese saying "bitter as the plumule of the lotus seed." A kind of bread is made of the seeds in Egypt, whilst they are also used as a remedy for indigestion, &c. Starch is extracted from the roots which is highly prized for its reputed strengthening properties; but this does not by any means exhaust all the virtues attributed to this wonderful plant. The Chinese materia medica, however, is said to present too many incongruities to permit of implicit reliance being placed upon the numerous medicinal properties associated with it, but the roots are on sale in considerable quantities, Mr. Blasdale informs us in his report, throughout the winter and early spring months in the Chinese market of San Francisco.

It is popularly supposed that the Chinese live almost entirely upon rice and that their diet is limited in amount, the apostles of vegetarianism not infrequently quoting the Chinaman as an example of how large an amount of hard work can be accomplished on a vegetarian diet. Studies, however, made in the Chinese quarter of San Francisco¹ do not support this theory, but show that whilst much more varied than that of an American or European, the Chinese diet is neither scanty in amount nor inferior in nutritive quality, whilst it is decidedly more varied and far cheaper than that of the former.

Thus, in the dietary study of a Chinese dentist's family living in comfortable circumstances and fairly typical of the average Chinese professional man, it was found that whilst the total amount of nutrient actually consumed per man per day agreed very closely with that suggested, as the result of inquiry, as a standard for a man engaged upon light muscular work, viz. 112 grams protein and 3150 calories of energy, the cost per man per day in the case of the Chinaman's family was about 50 per cent. less than that which experience has shown to be the average expenditure in the family of a professional man of the same position in the United States.

On inquiring more closely into the nature of the diet of this Chinese family, we find that as regards the source of animal protein pork took the first place, supplying nearly one-third of the total; fish comes next, followed by chicken, and last on the list is beef. The main vegetable food was rice, but considerable quantities of bread and other cereal products were also used, and a large amount of cheap green vegetables, the greater part of the latter being Chinese varieties. Amongst the unfamiliar articles of food recorded were dried crabs, dried shrimps, dried radishes, taro root, bean sprouts, bean cheese, dried fungus, lily petals, algae, bamboo shoots and the leprosy gourd. Tea and coffee were used as beverages, and the daily expenditure per head for these was 0.5 cent.

Dietary studies of Chinese engaged upon hard physical labour such as prevails on a Chinese truck farm or vegetable garden, again, showed that the diet adopted furnished very nearly the amount of animal protein and calories of energy commonly accepted as the standard of that required by a man in active work, i.e. 150 grams protein and 4500 calories. In this case also the diet was very varied, and we find included among the peculiarly Chinese articles of food water-lily roots, dried lily flowers, water chestnuts, bean cheese, dried fungus, &c. The cost per head per day was 19.7 cents, and Prof. Jaffa, who furnishes the report on these Chinese diet studies, says that as regards the Chinaman's capability for work there is no question; "few Americans could walk as he does for hours at a stretch, often up and down hill, burdened with a load of from 300 to 400 pounds in the baskets which he carries suspended by ropes to a pole balanced across one shoulder, whilst in adverse circumstances, such as long hours, great heat or exposure to cold and dampness, a Chinaman can not only do more work, but can stand the strain better than a strong white man."

Let us now turn to some of the dietary studies made in New York city amongst the poorer classes and reported by Messrs. Atwater and Woods. The district selected is described as "one of the worst congested and typical of the portions of the city known as slums," whilst the families selected for dietary study were chosen as representative of the population of the district. The diet of no less than twenty-one different families over a period of ten days was carefully recorded, and the results obtained are of much economic importance, showing that in many cases unwise expenditure is fully as responsible for distress as a too limited income.

As an instance of this the case of a mechanic's family in very poor circumstances may be cited. This family had received a great deal of help from the Association for the Improvement of the Condition of the Poor, and yet it was found that the expenditure on food was nearly twice that per head in the family of a well-to-do professional man, hardly anything being left over from the wages earned for fuel, lights, clothing and the many other requirements of a family. The food consumed furnished at least 25 grams of protein and 600 calories of energy per head in excess of that required by a man at moderate work. Whilst the amount of food purchased could have been reduced 25 to 30 per cent., a more judicious selection of the same and more skill in its preparation would have enabled a

¹ From inquiries it was ascertained that the system of diet adopted by the Chinese in San Francisco differs but little from that of the Chinese in their own country.

large proportion of the money spent on food to have been expended on other things.

What applies to this family applies equally to many of the other families in which dietary studies were carried out, and over and over again we find it stated that more food was purchased than was necessary for efficient nourishment. To each dietary study is appended criticisms of and suggestions for changes and improvement in the diet pursued, and these constitute a valuable addition to the report and form, indeed, an eloquent argument that our school curriculum should provide for the education of children in the elementary principles of diet in relation, not only to the economy of the body, but also to that of the family purse.

The selection of food stuffs on rational or scientific principles does not, perhaps, sound appetising, but the numerous investigations on the nutritive value attaching to substances which have been carried out in America and elsewhere cannot be overlooked, and it is, perhaps, not unreasonable to believe that current notions on diet may become modified in the future, more especially in those cases where on economical grounds reform is so urgently needed. These studies are, therefore, of social as well as scientific importance, and acquire particular significance for the poor at times when taxes shall tell heavily upon their resources.

In conclusion, brief reference may be made to the elaborate experiments which have been carried out on the different degrees of waste entailed in the different methods adopted for the cooking of food of various kinds.

Amongst the names associated with investigations on the loss of nutrients in the cooking of meat, we find that of Thudicum in this country, Vogel and König in Germany, whilst in America the most recent contributions to this subject have been made by Grindley, in conjunction with Messrs. McCormack and Porter. As regards the loss in weight which takes place, various investigators agree in stating it to be from one-fifth to one-third, whether the meat be boiled or roasted. Where beef, for example, is cooked in water, from 3 to 20 per cent. of the total solids is found in the resulting broth, the degree of loss in constituents appearing, to a certain extent, to depend upon the size of the piece of meat employed, the smaller the dimension it is reduced to the greater being the loss; whilst the duration of time of cooking must also be taken into consideration, the more prolonged it is the greater, again, being the loss entailed. The practical lesson to be learnt from the investigations which have so far been made appears to be that the most economical method of cooking meat is to broil it in a frying-pan, for in this manner the least loss of nutrients occurs.

In the case of vegetables, the losses entailed by cooking appear to be even greater than those recorded for meat. Thus as regards carrots, in boiling them nearly one-half of the mineral matters present are lost, together with about 40 per cent. of the total nitrogen and about 26 per cent. of the sugar present.

These percentages of loss or waste may be considerably reduced if the carrot is boiled whole instead of being first cut, as is customary, into small pieces. In this manner the loss in sugar, for example, instead of being 26 per cent., is reduced to very nearly half that amount, and similar economies may be effected in regard to the other constituents of the carrot.

In boiling cabbages the loss is very considerable, from 35 to 40 per cent. of the total nitrogenous matter present being left in the water, which, as everyone knows, is consigned to the kitchen sink as rapidly as possible. The Scotch recipe for making broth, which involves the addition of uncooked cabbage to the stock-pot, besides being justly renowned for the excellent results it produces, has also, therefore, distinct advantages from an economic point of view. As regards potatoes, we cannot do better than follow the custom of cooking them which prevails in the Emerald Isle. The Irish method of boiling potatoes in their skins is not only the most palatable, but also the most economical way of using them, for when potatoes are peeled and then boiled there is a very considerable loss, not only of organic nutrients, but also of the mineral salts present.

The above brief review may help to emphasise the economic importance quite apart from the scientific interest attaching to such investigations, for by indicating, not only the best means of utilising the existing sources of food supply, but also for extending their range, such researches may conceivably contribute not a little to the prosperity of a country as a whole, whilst they can undoubtedly promote the well being and to a certain extent, therefore, the happiness of the individual.

G. C. FRANKLAND.

MAGNETIC OBSERVATIONS IN BADEN.

AN account of a minute magnetic survey of a small district in Baden, adjacent to the Rhine, where there is considerable local magnetic disturbance, has been received from the author. Observations of horizontal force were made at nearly 400 stations, and observations of declination and inclination were made at about 140 of them. The object seems to have been to observe at a large number of stations with moderate accuracy in a short time. In fact, most of the data recorded in the tables on pp. 6-26 seem to have been obtained in the two months August and September of 1898. Horizontal force was observed only to the nearest 0.001 C.G.S., and declination and inclination usually only to the nearest 0.1. Within the narrow region dealt with—some 150 square kilometres—declination was observed to vary between 3° 7' W. and 20° 8' W., inclination between 56° 6' and 72° 0', and horizontal force between 0.173 and 0.227 C.G.S. In a district so disturbed, it would have been of doubtful advantage to have employed superior instruments, giving a higher order of accuracy than that actually aimed at. The results are embodied in four charts, which give respectively the lines of equal horizontal force, the isoclinals, the isogonals, and particulars of the horizontal and vertical components of the disturbing force system. The chief conclusions appear on p. 39. The most interesting of them is that the basaltic rocks—using *basaltic* in a general sense—which form the chief hills in the district, behave mostly like vertical magnets with their north poles uppermost. Their magnetisation is thus *opposite* to what it would be if induced under the action of the earth's own field. The phenomena thus differ in a remarkable way from those observed by Rücker and Thorpe in the United Kingdom. A second somewhat interesting deduction from the observations is that there is an extension of underground basaltic masses beneath part of the level country adjacent to the Rhine near Breisach, where local disturbances would not have been anticipated from the superficial appearance of the country. The author also gives the results obtained from taking a line integral of the horizontal magnetic force round the whole district and round four subdivisions. With the exception of one of the smaller subdivisions, the departure of the line integrals from zero is very small. This may be regarded as evidence of the accuracy of the observations, if we assume that the magnetic forces are derivable from a potential, which can hardly fail to be the case so far as concerns the field answering to the local disturbances. C. C.

THE ORIGIN OF THE THOROUGHBRED HORSE.²

THE author said that he had shown (*Academy*, January, 1891, p. 91) that not only, as had been long observed, did the Homeric Greeks drive the horse before they rode him, but that the same was true of all ancient peoples—Egyptians, Canaanites, Assyrians, Aryans of Rig-Veda, Umbrians, Celts—and that the explanation of this was given by Herodotus (v. 9), who, in speaking of the Sigynnæ, the only tribe north of the Danube, whose name he knew, said that they had small horses, with large flat noses and very long hair, which, though not able to carry a man, were excellent under chariots: "wherefore they used chariots." Dio Cassius likewise says that the Britons used chariots in war, because their horses were "small though active." The description of the horses of the Sigynnæ tallies exactly with the abundant remains of the primitive horse of Europe, eaten in great quantities and delineated on antlers by the men of the Stone Age. He was a small animal about 10 hands high with a big head. Even after domestication he remained very small, as witness bits of bronze and horn found in Swiss lake dwellings, the shoes found at Silchester, and in camps on the Roman Wall, &c. Authorities are agreed that from this primitive horse has been developed the cart horses of the continent and these islands, whilst our blood horses have come from an eastern stock of slight build and smart appearance. Our problem is to ascertain the original habitat of this superior horse. He has not come from upper Asia, as the Mongolian pony is taken as the type of the coarse, thickest horse from which sprang the cart horse. The Mongolian pony probably

¹ "Erdmagnetische Untersuchungen im Kaiserstuhl." Von Dr. G. Meyer. Mit 4 Karten. (Separatdruck aus den Berichten der Naturforschenden Gesellschaft zu Freiburg i. B. Bd. xii., 1902.)

² Abstract of paper read before the Cambridge Philosophical Society on November 24, by Prof. Ridgeway.